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**On the origin of worries about modern health hazards: experimental evidence for a
conjoint influence of media reports and personality traits**

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Abstract

Objective: Worries about health threatening effects of potential health hazards of modern life (e.g. electric devices and pollution) represent a growing phenomenon in Western countries. Yet, little is known about the causes of this growing special case of affective risk perceptions termed Modern Health Worries (MHW). The purpose of this study is to examine a possible role of biased media reports in the formation of MHW. **Design:** In two experiments, we investigated whether typical television reports affect MHW. In Study 1, 130 participants were randomly assigned to a film on idiopathic environmental intolerance (IEI) or a control film about cystic fibrosis. In Study 2, 82 participants were randomly assigned to either a film on the dangers of electromagnetic fields or a control condition. **Main Outcome Measures:** Increases in MHW after sensational media reports. **Results:** In Study 1, only participants high on the personality trait of absorption revealed increased MHW after watching the IEI film. In Study 2, specifically worries about radiation were found to be elevated after watching the film on the dangers of electromagnetic fields compared to the control film. **Conclusion:** The results of both studies reveal a significant and specific influence of sensational short mass media reports on MHW. The influence of potential moderators such as absorption remains to be clarified.

Key words: Modern Health Worries (MHW); Idiopathic Environmental Intolerance (IEI); Idiopathic Environmental Intolerance attributed to electromagnetic fields (IEI-EMF); electrosensitivity; absorption

On the origin of worries about modern health hazards: experimental evidence for a conjoint influence of media reports and personality traits

Concerns about the adverse health effects of modern technologies or industrialization are widespread in Western countries (Petrie et al., 2001; Petrie & Wessely, 2002) and have attracted the attention of health risk research since the 1980s (e.g. Slovic, 1987). Typical examples of current presumed “modern” health risks (termed “modern health worries” in the following) comprise genetically modified food, non-audible infrasound emitted by windfarms (Crichton, Dodd, Schmid, Gamble, & Petrie, 2014) as well as weak electromagnetic fields (e.g. WiFi radiation; Bergqvist et al., 1997). Recently, Rief, Glaesmer, Baehr, Broadbent, Brähler, and Petrie, (2012) examined a representative German population sample and reported that only 6% of the participants reported no modern health worries (MHW) at all. This wide prevalence of MHW stands in contrast to the constantly improving standard in medical care and the general increase in life expectancy attributable to modern technologies and processes (Barsky, 1988).

Health psychology research into the determinants of idiosyncratic health risk perceptions as a key component of health behaviour theories (Shiloh, Wade, Roberts, Alford, & Biesecker, 2013) has highlighted the importance of considering affective and emotional processes in addition to purely rational cognitive processes leading to the formation of the risk as feeling hypothesis (Loewenstein, Weber, Hsee, & Welch, 2001; Slovic, Peters, Finuncane, & MacGregor, 2005). In the realm of cancer risk perception research, it has been demonstrated that only the affective risk perception component (with strong associations to the worry construct) but not cognitive likelihood estimations were significantly associated with health behaviour (Janssen, van Osch, Lechner, Candel, & de Vries, 2012). Arguably, the emotional representations of potential health threats in case of modern health worries does not follow strict rational statistical considerations about objective threats to ones state of health but rather

represents an intuitive affective judgment of yet unclear origin. Psychometric risk perception research yielded two distinguishable dimensions of individual threat perceptions, namely novelty/unfamiliarity (i.e. rather unknown and unobservable risks, e.g., chemicals, genetically modified food, radiation) and dread level (i.e. uncontrollability and fatal consequences, e.g., nuclear reactor accidents) (Slovic, 1987). Particularly the issue of novelty and unfamiliarity represents a defining feature of MHW and partly helps to explain the risk perception gap (Ropeik, 2011), i.e., the discrepancy between objective facts (suggesting a rather low threat potential compared to known causes of death such as smoking or physical inactivity) and subjective fears. In this regard it appears relevant that mass media coverage appears to be biased in favoring new emerging potential health hazards compared to known health risks. In a study from the US analyzing the number of media reports about health threats in 2003, a strong negative correlation between the actual number of deaths and the number of media reports was observed suggesting a clear underrepresentation of objective health risks (e.g. smoking, HIV) in favour of new emerging health threats (e.g. SARS, bioterrorism) (Bomlitz & Brezis, 2008). Systematic research on MHW started with the development of the Modern Health Worries Scale (MHWS), a self-report instrument that assesses the degree of worries regarding potential environmental threats to health (Petrie et al., 2001). The translation of the originally English MHWS into several languages has enabled recent international and cross-cultural studies of MHW and its correlates (e.g. Köteles, Szemerszky, Freyler, & Bardos, 2011; Ozakinci, Boratav, & Mora, 2011). As a result, three major findings have emerged: First, MHW are significantly correlated with the report of subjective health complaints and somatoform symptoms even after statistically controlling for trait negative affect (Bailer, Bähr, Stubinger, & Witthöft, 2008a; Garcia-Altes, Pinilla, & Ortun, 2011; Petrie et al., 2001; Rief et al., 2012). Second, higher levels of MHW are positively correlated with health care use (Kaptein et al., 2005) and especially

complementary and alternative medicine use (Furnham, 2007, Köteles, Barany, Varsanyi, & Bardos, 2012; Petrie et al., 2001). Third, Bailer and colleagues (Bailer et al., 2008a) found evidence for a close connection between higher levels of MHW and a disabling chronic health condition termed Idiopathic Environmental Intolerance (IEI). IEI is considered as a functional somatic syndrome of yet unexplained etiology and pathogenesis marked by multiple and unspecific intolerance reactions to low-levels of everyday chemicals or other environmental triggers (e.g. electromagnetic fields) that are considered harmless for the general population from a toxicological or physical perspective (e.g. Das-Munshi, Rubin, & Wessely, 2007). Empirical evidence showed that especially somatic symptoms related to IEI (e.g. headache, fatigue, and respiratory symptoms related to low-dose chemical exposure or other environmental triggers) mediated the association between MHW and doctor visits. Accordingly, increased levels of MHW might be considered as a cognitive risk factor for the development of IEI attributed to chemicals (Bailer et al., 2008a) or electromagnetic fields (IEI-EMF; Rubin, Cleare, & Wessely, 2008).

Despite these findings, little is known about the origins of MHW themselves. It has been hypothesized that the popular media, with its tendency to overemphasize the importance of toxic or environmental causes of illness (Eldridge-Thomas & Rubin, 2013; Huiberts, Hjørnevik, Mykletun, & Skogen, 2013), might play a role in fostering MHW and related conditions (e.g. Bailer et al., 2008a; Petrie et al., 2001; Van den Bulk & Custers, 2008;). Particularly one previous study (Winters et al., 2003) is highly relevant in this regard because using a differential conditioning paradigm, it could be demonstrated that media warnings (leaflets about negative health effects of environmental pollution) were able to create somatic symptoms in the laboratory by forming a conditioned response (in an olfactory differential conditioning paradigm using CO₂-enriched air as the unconditioned stimulus and an aversive but harmless smell as the

conditioned stimulus). Only participants exposed to the warning message showed somatic symptoms as a conditioned response to the aversive odor but no members of the control groups that were not pre-exposed to the warning message. Further examples for the ability of media reports in creating negative expectations that can foster the perception of somatic symptoms stems from research on potential harmful effects of ultrasound emitted by windfarms. Whereas ultrasound itself is unable to create somatic symptoms, negative expectations created by media reports on potential health threats due to ultrasound were able to cause symptom reports in healthy participants (Crichton et al., 2014). Similarly, an advertising film for health protecting products against potential harmful health effects of everyday electromagnetic fields was shown to increase worries concerning radiation as well as the heart rate among participants (Köteles, Tarján, & Berkes, 2016). Further evidence stems from research into the fear of cervical cancer (Lemal, & Van den Bulck, 2011), where positive associations between media reports and an increased health risk perception could be demonstrated.

Based on these previous findings regarding media reports on health risk perception, we hypothesized that television reports that focus on the harmful consequences of environmental substances and agents would be able to increase MHW. We also hypothesized that the effect of the film provocation might be moderated by personality traits that have been found to be linked to MHW and risk perception. Previous research in the realm of health related media exposure effects found evidence for a moderating role of personality factors (e.g. optimism) for the levels of anxiety elicited by news media reports (McNaughton-Cassill, 2001). Because previous studies on MHW and IEI found significant associations with certain personality traits (Bailer et al., 2008a; Bailer, Withhöft, & Rist, 2008b), we assumed that especially two traits might represent relevant moderators: The personality trait of negative affectivity (i.e. the predisposition and propensity to more frequently experience states of negative mood associated with a negative self-

view and more distress related somatic symptoms; Watson & Clark, 1984; Watson & Pennebaker, 1989) has previously been observed to be significantly related to MHW (e.g., Bailer et al., 2008a; Köteles et al., 2011). Based on the risk as feeling hypothesis (e.g. Slovic & Peters, 2006), high dispositional levels of negative affect may also make people more vulnerable towards more negative intuitive health related risk perceptions in terms of worries. The personality trait of absorption that is closely related to suggestibility, openness to experiences, fantasy proneness, the experience of altered states of consciousness (Ott, Reuter, Hennig, & Vaitl, 2005; Tellegen & Atkinson, 1974; Vaitl et al., 2005) as well as medically unexplained symptoms and somatoform disorders (e.g., Brown, 2004; Kirmayer, Robbins, & Paris, 1994) might represent another promising construct related to MHW. Absorption is defined as “a disposition for having episodes of ‘total’ attention that fully engage one’s representational (i.e., perceptual, enactive, imaginative, and ideational) resources” (Tellegen & Atkinson, 1974, p. 268). Higher levels of absorption have been found to be associated with IEI (Witthöft, Rist, & Bailer, 2008), presumably because absorption renders people more vulnerable for rather unusual and new attributions for medically unexplained symptoms. Given the positive link between IEI and MHW, it is concluded that absorption might also be involved in the formation of MHW as well. In line with prominent theories of attitude formation and health behaviour (e.g. the Integrated Change Model; de Vries, Mesters, van de Steeg, & Honing, 2008), we consider personality factors (i.e. traits) as distal concepts that together with current media information (as proximal factors) influence the affective components of risk perceptions (i.e. worries). Accordingly, we hypothesized that participants with higher levels of absorption (hypothesis 1) and negative affectivity (hypothesis 2) show higher levels of MHW after watching a film on harmful consequences of environmental agents compared to participants with lower levels on these traits. The assumed model regarding the associations between distal personality factors (i.e.

absorption and negative affectivity), and proximal environmental influences (i.e. media reports about modern health hazards), and individual worries about modern health hazards are depicted in Figure 1.

Study 1

Method

Participants. Participants were recruited by posters and leaflets distributed at a German University and via word-of-mouth recommendation. People were encouraged to further distribute the study information among their friends and relatives to reach a wider and more heterogeneous sample. The study was advertised as an internet based study on “modern technologies, physical well-being, and health related worries”. The study consisted of two parts, i.e. a paper-pencil questionnaire and a following internet-based experiment (please see the procedure section below). In the first part, 260 questionnaires were handed out to potential participants and 170 (65.4%) were returned (filled in questionnaire where either personally returned to the Psychological Institute or were sent by mail). The questionnaire included a URL which led to a second, internet-based part of the study and a code number to log in to a secured website anonymously. 141 participants took part in this second part of the experiment. Of these, the data of 10 people had to be excluded from the final analysis because of missing data for the first part of the experiment. We also excluded one participant with extreme values regarding the main dependent variable. Sample characteristics of the remaining 130 participants are summarized in Table 1.

Please insert Table 1 about here

Measures. *The Modern Health Worries Scale (MHWS)* (Petrie et al., 2001; Petrie & Wessely, 2002) assesses the degree to which people are concerned about possible health-related risk factors associated with modern life. It consists of 25 items with a 5-point Likert scale ranging from *no concern* (1) to *extreme concern* (5), with four subscales: concerns about radiation (3 items; possible range: 3-15), concerns about environmental pollution (6 items; possible range: 6-30), concerns about tainted food (5 items; possible range: 5-25), and concerns about toxic interventions (11 items; possible range: 11-55) (Bailer et al., 2008b). The MHWS has good psychometric properties in terms of reliability and validity (Bailer et al., 2008b; Petrie et al., 2001; Kaptein et al., 2005).

The Tellegen Absorption Scale (TAS; Tellegen, 1982) was used to measure absorption. The TAS is the most widely used instrument for the assessment of absorption (Roche & McConkey, 1990). In its well-validated German version (Ritz & Dahme, 1995), respondents are asked to rate 34 items on a five-point Likert scale ranging from 0 (*does not apply*) to 4 (*does fully apply*).

Positive and Negative Affect Scale (PANAS; Watson, Clark, & Tellegen, 1988). The PANAS consists of a positive and a negative subscale, with each scale consisting of 10 adjectives. The answer format is a 5-point Likert scale ranging from *very slightly or not at all* to *extremely*. The PANAS was used to detect possible differences in positive and negative state affect after viewing the two television reports.

The State Trait Anxiety Inventory (STAI). Trait anxiety as a possible moderating variable was assessed with the German version of the STAI (Laux, Glanzmann, Schaffner, & Spielberger, 1981).

Procedure. The study consisted of two parts. In the first part (duration: 15 to 20 minutes), participants completed paper questionnaires containing demographic items and the

MHW, STAI, and TAS. In the second, internet-based part of the study (duration: 20 to 30 minutes) participants were randomly assigned to one of two television reports. In the experimental group (EG; $n = 60$), people viewed parts of a television documentary (duration: 8:22 minutes) that was broadcasted in the German public television in 2008. In this documentary, potential health threats from chemicals in our environment were described and a patient who was severely impaired by IEI and therefore had to live in a caravan outside any town spoke about his symptoms and difficulties in daily life. The focus of the film was primarily on the patient's experience of somatic symptoms and his difficulties in daily life. Although, from a scientific perspective, a pure somatic and toxicological causal mechanism of IEI is highly unlikely, the film focused on such a biological model that was favored by the patient without any mentioning of alternative explanatory accounts. This one-sided presentation of biological causal mechanisms (despite conflicting scientific evidence) is quite common in media reports on IEI across Europe (Eldridge-Thomas & Rubin, 2013; Huiberts et al., 2013). The second group (control group; CG; $n = 70$) received a very similar television documentary from the same series (duration: 8:09 minutes) about a patient suffering from cystic fibrosis which contained no reference to potential environmental threats to health. This control film similarly focused on the patient's symptoms and difficulties associated with living with a severe chronic disease. Compared to the IEI-film, the disease in this film represents an officially acknowledged disease. Both films were part of a respected weekly series of documentaries in the German public television with viewing rates around 2-3 million. The two television documentaries, which originally lasted about 30 minutes, were shortened to a length of about 8 minutes to keep the testing time in an acceptable range and to prevent people from prematurely terminating their participation. After watching the film, participants received six questions referring to the content of the respective film clip in order to assure that participants actually watched the film clips (mean accuracy scores were high for both

films, 94% correct for the IEI film and 96% for the cystic fibrosis film, with no significant difference between the two film conditions, $t(128) = -0.96$; $p = .338$). Subsequently, participants completed the PANAS and MHWS. Finally, participants received a debriefing regarding the purpose of the study and were provided with contact details in case of further questions concerning the study.

Data analyses. Following the recommendations of Fitzmaurice, Laird, and Ware (2004) regarding longitudinal data-analysis in randomized designs, an ANCOVA design was chosen to analyze the effect of the film condition on individual levels of MHW. In this analysis, the second assessment of MHW after viewing the film served as the dependent variable and the first assessment of MHW as the covariate. The film content (environmental health threat vs. control condition) was added as a between-groups factor. In separate analyses, the personality trait of absorption (TAS) and trait negative affectivity (STAI) were considered as dichotomous between-group variables by forming groups of participants with high and low levels of absorption and negative affectivity according to the median (TAS median = 48.50; NA median = 41.00)¹. This procedure was used for the MHW total score as well as for the four MHW subscales (i.e., concerns about radiation, about environmental pollution, about tainted food, and about toxic interventions). Effect sizes are reported as partial η^2 values (η_p^2) for ANCOVA results and as Cohen's d for between group comparisons. All significance tests are two-tailed with $p < .05$.

Results

Descriptive statistics prior to the experiment and affect ratings after the film. The

¹ We are aware of the potential dangers and shortcomings of using median-splits for continuous variables. We therefore repeated data analysis by using a multiple regression approach to moderation analysis. Because equivalent results were observed, we decided to use the outlined ANCOVA for reasons of clarity of presentation.

two experimental groups (EG and CG) did not differ significantly with regard to age, individual levels of trait anxiety, or MHW prior to the experiment (Table 1). A marginally significant difference in the sex distribution was observed ($p = .054$) because of slightly more male participants in the CG compared to the EG. Internal consistencies for all measures used in Study 1 were good to excellent (Table 1). Levels of negative and positive state affect assessed directly after watching the two film conditions revealed significantly more negative state effect in the EG compared to the CG, but no difference regarding positive state affect (Table 1). The zero-order correlations between relevant constructs at baseline are presented in Table 3.

Hypothesis 1: Viewing the environmental threat film in interaction with the trait of absorption is related to higher levels of MHW. In the ANCOVA on the pre-post effects of MHW, no significant main effect for the factor Film was observed ($F(1, 125) = 1.05, p = .308, \eta_p^2 = .01$). Regarding the personality trait of absorption, a significant main effect, $F(1, 125) = 3.97, p = .048, \eta_p^2 = .03$, was observed that was attributable to higher levels of MHW in the high absorption compared to the low absorption group. Finally, there was a significant Film \times Absorption interaction effect, $F(1, 125) = 7.40, p = .007, \eta_p^2 = .06$. Post-hoc t tests revealed that people high on absorption, $t(63) = 3.03; p = .004; d = 0.75$, but not low on absorption, $t(63) = -1.23; p = .224; d = -0.31$, had a significant increase in MHW after watching the environmental threat related film compared to the control film. Adding sex as a covariate (because of the marginally significant difference between the EG and the CG) had no effect on these results. Adding negative state affect as a covariate decreased the main effect of absorption, $F(1, 124) = 1.86, p = .176, \eta_p^2 = .02$ and slightly reduced the magnitude of the Film \times Absorption interaction effect, $F(1, 124) = 5.75, p = .018, \eta_p^2 = .04$.²

² We are aware of the potential dangers and shortcomings of using median-splits for continuous variables. We therefore repeated data analysis by using a multiple regression approach to moderation analysis. Because equivalent results were observed (i.e. a significant moderation effect of absorption for the association between the film

Hypothesis 2: Viewing the environmental threat film in interaction with the trait of negative affectivity is related to higher levels of MHW. Repeating the ANCOVA with negative affectivity as a dichotomous between subjects factor did not reveal a significant main effect of negative affectivity, $F(1, 125) = 2.51, p = .116, \eta_p^2 = .02$, or a significant Film \times Negative affectivity interaction effect, $F(1, 125) = 0.42, p = .519, \eta_p^2 < .01$.²

Please insert Figure 1 about here.

Exploratory analyses: Testing possible effects of the environmental threat film on the MHW subscales and absorption as a moderator. Repeating the ANCOVA for the four different MHW subscales revealed no significant effect of either the factors Film, $F(1, 125) = 2.32, p = .130, \eta_p^2 = .02$, Absorption, $F(1, 125) = 1.67, p = .199, \eta_p^2 = .01$, or their interaction, $F(1, 125) = 1.23, p = .270, \eta_p^2 = .01$, in case of the radiation subscale. However, similar effects as in the MHW total score were found with regard to the Tainted Food subscale (Film: $F(1, 125) = 1.76, p = .187, \eta_p^2 = .01$; Absorption: $F(1, 125) = 3.79, p = .054, \eta_p^2 = .03$; Film \times Absorption interaction: $F(1, 125) = 10.39, p = .002, \eta_p^2 = .08$, as well as for the Environmental Pollution subscale (Film: $F(1, 125) = 1.07, p = .302, \eta_p^2 = .01$; Absorption: $F(1, 125) = 3.06, p = .083, \eta_p^2 = .02$; Film \times Absorption interaction: $F(1, 125) = 6.21, p = .014, \eta_p^2 = .05$). The analysis for the Toxic Interventions subscale only showed a significant main effect of Absorption, $F(1, 125) = 4.86, p = .029, \eta_p^2 = .04$, attributable to higher worries regarding toxic interventions in people with higher absorption scores. However, this effect was not moderated by the factor Film, $F(1, 125) = 0.72, p = .399, \eta_p^2 < .01$, and no main effect of the factor Film could be observed either,

condition and the increase of MHW: $\beta = .22; p = 0.01$; no significant moderation effect of negative affectivity: $\beta = .01; p = 0.89$), we decided to use the outlined ANCOVA for reasons of clarity of presentation).

$F(1, 125) = 0.73, p = .394, \eta_p^2 < .01$.

Exploratory analyses: Testing possible effects of the environmental threat film on the MHW subscales and negative affectivity as a moderator. Repeating the ANCOVAs for the MHW subscales including negative affectivity as a dichotomous between subjects factor did not reveal any significant main effect of negative affectivity ($F_s < 2.40; p_s > .12; \eta_p^2 < .02$) or a significant Film \times Negative affectivity interaction effect ($F_s < 1.17; p_s > .28; \eta_p^2 < .01$).

Please insert Figure 2 about here.

Discussion

The aim of Study 1 was to test whether a short film about possible health threats of everyday chemicals in our environment is able to increase individual levels of MHW and whether this effect is moderated by certain personality traits that may be related to MHW. Although the environmental threat related film did not increase MHW in general, we observed that participants high on absorption reported significantly more MHW after watching the environmental health threat film compared to participants low on absorption watching the same film. No such moderating influence could be detected for trait negative affectivity.

Although this finding may come as a surprise, the associations previously observed between negative affectivity and MHW were mostly small in size (e.g. Filipkowski et al., 2010). In essence, the findings of Study 1 suggest that increases in MHW might best be understood in terms of an interaction effect of situational factors (e.g. a particular television report) and dispositional factors (i.e. the personality trait of absorption). The personality trait of absorption has previously been linked to the experience of somatoform symptoms in general (Kirmayer et al., 1994), hypochondriacal concerns (McClure & Lilienfeld, 2002), and symptoms of IEI in specific (Withhöft et al., 2008). Given the relation of the absorption construct to suggestibility,

hypnotizability, and openness to experience (Tellegen & Atkinson, 1974), it appears likely that people high on absorption are more vigilant in experiencing bodily sensations of all kind and might also be more susceptible to consider potential health threats presented in television reports as personally relevant. It is worth noting that this effect does not seem to be driven or mediated by negative affectivity given the null findings regarding the role of negative affectivity in the above analyses. Additionally, high levels of absorption have been observed to be related to the preference of more curious and unusual convictions and attributions of bodily sensations (Clancy, McNally, Schacter, Lenzenweger, & Pitman, 2002). The findings of Study 1 are also in accordance with a recent study that reported associations between a holistic, intuitive thinking style and MHW (Köteles, & Simor, 2014). It appears plausible that a more intuitive and less rational thinking style is associated with a greater potential of media reports to affect health related beliefs.

Several limitations of Study 1 have to be acknowledged. First, and perhaps most importantly, the main part of the experimental study was designed as an online experiment. Although, this procedure is economical and convenient for participants, the procedure lacks the high degree of experimental control which can be achieved in laboratory experiments. Second, no specific hypotheses were developed about which kind of MHW would be most strongly affected by the film about an IEI patient: the match between the film content and the MHW as the main dependent variable may not have been entirely compatible.

Study 2

The primary aim of Study 2 was to overcome the two most important limitations of Study 1 and to replicate its main findings. Study 2 was therefore designed as a laboratory experiment and not as an internet based study. Furthermore, we focused on one specific kind of modern

health worry in order to match the particular content of a media report to one particular domain of MHW, namely health related worries associated with electromagnetic fields (MHW-EMF). Using the same research design as in Study 1, we hypothesized (hypothesis 1) that a television report that focused on possible health threats of electromagnetic fields would specifically increase MHW-EMF but not other MHW (e.g. regarding tainted food or environmental chemicals). Based on the findings of Study 1, we further hypothesized (hypothesis 2) that the personality trait of absorption would amplify the effect of the EMF related film on MHW-EMF. A possible role of trait negative effect as a potential moderator for an increase of MHW-EMF by the television report was tested as well.

Method

Participants and procedure. As in Study 1, participants were recruited by advertisements at a German University and via word-of-mouth recommendation. Study 2 consisted of two parts: Participants ($N = 88$) in the first part completed an online based questionnaire including the MHWS, STAI, TAS, and biographical information. Of these 88 participants, 82 (57 female) participated in the second part of Study 2, in which participants were randomly assigned to the television report on EMF related dangers (experimental group; EG) or a control film (control group; CG). In the EG, participants were shown a part (duration: 8 min) of a television report broadcasted in 2009 in the public German television in which potential threats of health by the radiation emitted by mobile phones were addressed. In this film entitled “When the phone makes you ill”, rather sensational information was provided regarding the number of people possibly affected in their health by EMF and a patient was shown who was severely impaired by IEL-EMF. Additionally, several scientists were interviewed who highlighted the potential dangers of EMF. No counter arguments against the proposed (scientifically unsupported) bio-electromagnetic causal mechanism were mentioned. The CG received a film

(duration: 8 min) on the growing number of stolen mobile phones, which was broadcasted in German television in 2008. The two films were chosen in order to keep the general content (mobile phones) as similar as possible. After watching the film, participants again filled out questionnaires on state affect, EMF related worries, and MHW. Finally, participants were debriefed about the purpose of the study and received either monetary compensation or course credit equivalents for their participation.

Self-Report Measures. As with Study 1, trait anxiety was assessed with the STAI, positive and negative state affect with the PANAS, and individual levels of MHW with the MHWS. MHW-EMF were assessed with the radiation subscale of the MHWS and the Electromagnetic Fields Health Worry Scale (EMF-HWS; Augner, 2009). The EMF-HWS assesses the extent to which people worry about negative health related effects of EMF (e.g. mobile phone masts, high voltage power lines) on a 5-point Likert scale (ranging from *not at all* to *extremely*). A 12-item version of the EMF-HWS was used in the current study and revealed a high internal consistency (Cronbach's α of .89 at the first assessment and $\alpha = .94$ at the second assessment).

Data analyses. As in Study 1, an ANCOVA design was chosen. In this analysis, the level of MHW and especially worries regarding EMF after viewing the film served as the dependent variable. To control for original levels of MHW, the pre assessment of MHW (before the film) was used as a covariate. The film content (health risks of EMF vs. control condition) was added as a between-groups factor. Again, the personality traits of absorption and negative affectivity were considered as a dichotomous between-group variables by forming groups of participants with high and low levels of absorption according to the median (TAS median = 46.00; STAI median = 39.00). This data analytic procedure was used for the four different MHW subscales separately.

Results

Descriptive statistics prior to the experiment and state affect ratings after the film.

The two experimental groups (EG and CG) did not differ significantly with regard to sex, age, trait anxiety or MHW prior to the experiment (Table 2). Internal consistencies for all measures used in Study 2 were good to excellent (Table 2). Levels of negative and positive state affect assessed directly after watching the film did not differ significantly between experimental groups (Table 2). The zero-order correlations between relevant constructs at baseline are presented in Table 3.

Hypothesis 1: television reports focusing on possible health threats of electromagnetic fields specifically increase MHW-EMF but not other MHW (e.g. regarding tainted food or environmental chemicals). Submitting the EMF-HWS scores before and after the film to the outlined ANCOVA, a significant main effect for the factor Film, $F(1, 77) = 4.13$, $p = .046$, $\eta_p^2 = .05$, was observed reflecting higher EMF related worries in the EMF danger film condition compared to the control film condition. Analyzing the radiation subscale of the MHWS, again a significant main effect for the factor Film, $F(1, 77) = 4.31$, $p = .041$, $\eta_p^2 = .05$, was observed reflecting higher worries regarding radiation after the EMF danger film condition compared to the control film condition (Figure 4). Repeating the ANCOVA for the three other MHW subscales (i.e., Environmental Pollution, Tainted Food, Toxic Interventions) revealed no significant main effect of the factor Film (Environmental pollution: $F(1, 77) = 0.27$, $p = .607$, $\eta_p^2 < .01$; Tainted Food: $F(1, 77) = 0.15$, $p = .701$, $\eta_p^2 < .01$; Toxic Interventions: $F(1, 77) = 0.84$, $p = .363$, $\eta_p^2 = .01$).

Hypothesis 2: the personality trait of absorption amplifies the effect of the EMF related film on MHW-EMF. Submitting the EMF-HWS scores before and after the film to the outlined ANCOVA, no significant effects were observed for Absorption, $F(1, 77) = 0.36$, $p =$

.550, $\eta_p^2 < .01$, or the Film \times Absorption interaction effect, $F(1, 77) = 0.21, p = .649, \eta_p^2 < .01$. Analyzing the radiation subscale of the MHWS, again no significant effects were observed for Absorption, $F(1, 77) = 1.04, p = .311, \eta_p^2 = .01$, or the Film \times Absorption interaction effect, $F(1, 77) = 1.34, p = .250, \eta_p^2 = .02$. Regarding the other MHW subscales, no significant effect of Absorption or the Film \times Absorption interaction emerged (Environmental pollution: Film: $F(1, 77) = 0.27, p = .607, \eta_p^2 < .01$, Absorption: $F(1, 77) = 0.80, p = .374, \eta_p^2 = .01$, Film \times Absorption: $F(1, 77) = 0.95, p = .334, \eta_p^2 = .01$; Tainted Food: Film: $F(1, 77) = 0.15, p = .701, \eta_p^2 < .01$, Absorption: $F(1, 77) = 1.53, p = .221, \eta_p^2 = .02$, Film \times Absorption: $F(1, 77) = 0.12, p = .734, \eta_p^2 < .01$; Toxic Interventions: Film: $F(1, 77) = 0.84, p = .363, \eta_p^2 = .01$, Absorption: $F(1, 77) < 0.01, p = .963, \eta_p^2 < .01$, Film \times Absorption: $F(1, 77) = 0.02, p = .892, \eta_p^2 < .01$).

Exploratory analysis: Testing a possible moderation effect of negative affectivity for an increase of MHW-EMF due to the threat film. Repeating the ANCOVAs for the EMF-HWS scores as well as the MHW subscales including negative affectivity as a dichotomous between subjects factor did not reveal any significant main effect of negative affectivity ($F_s < 2.01; p_s > .16; \eta_p^2 < .03$) or a significant Film \times Negative affectivity interaction effect ($F_s < 0.47; p_s > .49; \eta_p^2 < .01$).

Discussion

The results of Study 2 suggest that a short television report on the potential dangers of EMF is able to increase worries about EMF but not other MHW. This result was observed in two different measures of worries regarding EMF, the EMF-HWS and the radiation subscale of the MHWS. Additionally, the finding that no other subscale of the MHWS was affected by the EMF report lends support to the specificity hypothesis, i.e., that the observed increase in EMF related

worries is specifically associated with the film content of the EG. In contrast to Study 1, no moderating effect of the personality trait of absorption could be detected.

General discussion

Theoretical considerations and empirical findings in health psychology ascribe affective health risk perceptions a critical role in determining health related behaviors. Yet, little is known about the exact factors and mechanisms by which affective health risk perceptions (i.e. worries) develop. The current study aimed at testing a potential role of biased media reports for the development of affective risk perceptions (i.e. worries) in the realm of modern health hazards. The results of both studies suggest that television reports on health related risks and dangers of modern health hazards are capable of increasing MHW, either alone (Study 2) or in combination with the personality trait of absorption (Study 1). The observation that a main effect of the critical film was only present in Study 2 but not in the internet based Study 1 might suggest that a more controlled laboratory testing environment is more sensitive in detecting media effects on MHW. Alternatively, it might be possible that the influence of absorption is systematically reduced in a more controlled laboratory settings because absorption might only be relevant in more complex situations, in which multiple stimuli compete for attention (e.g. in case of responding to an online study at home when other persons or stimuli are simultaneously present). Under such naturalistic conditions, individuals high on absorption might tend to stronger focus on reports on novel health hazards despite of other stimuli being simultaneously present.³ Additionally, the existence of moderating personality factors (e.g. absorption) might also contribute to the difficulty to observe strong main effects of media reports on the level of MHW. Furthermore, the differences regarding the special type of MHW addressed in the two studies

³ We thank an anonymous reviewer for providing us with this plausible explanation.

might also account for the different findings. In this regard, it might be of note that two recent studies showed that MHW concerning EMF (e.g. cell phones, high tension power lines, or radio/cell phones towers) are reported less often than concerns about the harmful consequences of pesticides, environmental pollution, and toxic chemicals (Kaptein et al., 2005; Rief et al., 2012).

It is possible that the stability of MHW varies across the different MHW content areas.

Additionally, Studies 1 and 2 came to different conclusions regarding the role of absorption:

Whereas in Study 1 only people high on absorption showed an increase in MHW after watching the environmental illness related film, participants in Study 2 reported an increase in worries regarding EMF independent of their individual level of absorption. Unfortunately, any post-hoc explanation regarding this discrepancy must remain speculative. Possibly, the different focus and content of the two films was responsible for the finding: In Study 1, the report mainly focused on the life of a patient suffering from IEI. The potential environmental threats to health were more implicit (only indirectly reflected by the patient's illness and difficulties in daily life) compared to the report in Study 2, which more explicitly focused on possible dangers of EMF for everyone.

It is possible that people high on absorption became more immersed in the film and consequently more easily identified with the IEI patient in Study 1. The main finding of Study 2 that EMF related worries are particularly sensitive to sensational media reports could recently be confirmed in two independent studies conducted in the UK (Witthöft & Rubin, 2013) and Germany (Bräscher, Raymaekers, Van den Bergh, & Witthöft, 2017). In these laboratory studies, it could also be demonstrated that EMF related worries significantly predicted the occurrence and intensity of somatic sensations in response to an EMF sham exposure, suggesting that MHW are able to foster a nocebo effect. The observed association between media reporting and MHW is therefore not simply of academic interest but also of clinical relevance. High levels of MHW have been found to be significantly associated with dysfunctional cognitive, behavioural, and

somatic responses (i.e. increased somatic symptoms, avoidance behaviour towards objectively harmless environmental stimuli and excessive health care utilization; Bailer et al., 2008). Given the well documented association between MHW and health care use, our results suggest that uncritical and sensational mass media reports (or even calculated media campaigning) on possible dangers of modern life will not only increase MHW but also stimulate health care utilization (Figure 1). It is therefore suggested that theories of health risk perception and health behaviour should more explicitly include this biasing role of sensational media reports. Future research in terms of optimal risk communication should also explore ways to counteract the documented negative affective impact of sensational mass media reports, e.g., by providing explicit information regarding the existence of a nocebo effect (Webster, Weinman, & Rubin, 2016). A recent study on negative somatic symptoms triggered by an infrasound sham exposure demonstrated that giving information regarding the powerful role of negative expectations (i.e. the nocebo effect) is able to reliably reduce such nocebo effects (Crichton & Petrie, 2015).

Limitations

Although significant effects of the health threat related media reports in Study 1 and 2 were observed, the effect sizes were small to medium at best. It is speculated that these rather small effects might indicate that MHW represent a trait-like construct that depends on multiple sources of information and prior formed beliefs about potential health risks. Attempts to manipulate individual levels of MHW by single sources of information (e.g. one particular film clip) might therefore yield only small effects. Because only two potential moderators (i.e. negative affectivity and absorption) that have been found to be related to MHW and related conditions such as IEI were included in the current study, we cannot rule out the possibility that different or additional moderators are important in explaining possible associations between media reports and MHW. Possible candidates for such moderating traits that should be included

in future studies might be impulsivity, rational vs. intuitive decision style, and intolerance of uncertainty because this latter trait has been linked to a preference for threatening interpretations in ambiguous situations (Dugas, Hedayati, Karavidas, Buhr, Francis, & Phillips, 2005) suggesting a possible role in biasing risk perception in ambiguous situations. Furthermore, the current study is limited by not assessing critical construct related to health behavior change (e.g., risk perceptions, respective attitudes, intentions, and related behaviors). Additionally, our current testing approach allows for no conclusions on how persistent the observed changes in MHW are. Further studies with multiple assessments of MHW after the film conditions might shed light on this issue. A final limitation concerns the film clips used in our study: although the clips represent actual film clips that were broadcasted in German television, it is difficult to judge whether they are representative of the news coverage concerning modern health hazards. Also, we did not assess pre-exposure of participants to the film clips as well as individual levels of credibility (as a potential moderator). Still our findings are among the first to document a significant impact of sensational media reports on MHW. Since empirical evidence suggests that high levels of MHW serve as a central risk factor for the development of IEI as a chronic and disabling condition (Bailer et al., 2008b), the exact mechanisms of the development of MHW are of high relevance.

Conclusion

In sum, the two presented experimental studies support the hypothesis that mass media and especially television reports about the dangers of modern life may significantly contribute to the observed spread of MHW and might serve as risk factors for the development of medically unexplained environmental illnesses (e.g. IEI and IEI-EMF).

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Table 1

Sample characteristics and questionnaire data of Study 1

	Experimental film conditions		Test of significance (<i>p</i>)	Cronbach's α
	Film on environmental illness (IEI)	Control film on cystic fibrosis		
Sample size <i>N</i>	60	70		
Sex (female/male)	44/16	40/30	Chi ² = 3.70 (.054)	
Age <i>M</i> (<i>SD</i>)	32.97 (14.27)	32.27 (15.27)	<i>t</i> (128) = -0.27 (.790)	
Proportion college students <i>N</i> (%)	33 (55.0)	33 (47.1)	Chi ² = 0.80 (.39)	
MHWS total score at pre test <i>M</i> (<i>SD</i>)	58.77 (17.70)	61.43 (17.74)	<i>t</i> (128) = 0.85 (.395)	.95
Tellegen Absorption Scale <i>M</i> (<i>SD</i>)	52.87 (24.32)	48.24 (23.04)	<i>t</i> (128) = -1.11 (.268)	.94
Trait anxiety (STAI) <i>M</i> (<i>SD</i>)	41.75 (10.18)	41.30 (9.19)	<i>t</i> (128) = -0.27 (.792)	.92
Negative State Affect (PANAS) <i>M</i> (<i>SD</i>)	18.02 (7.35)	14.17 (4.14)	<i>t</i> (128) = -3.74 (< .01)	.88
Positive State Affect (PANAS) <i>M</i> (<i>SD</i>)	24.60 (4.50)	26.59 (7.99)	<i>t</i> (128) = 1.71 (.090)	.86

Note. IEI = Idiopathic Environmental Intolerance; MHWS = Modern Health Worry Scale; EMF = Electromagnetic fields; STAI = State Trait Anxiety Inventory; PANAS = Positive and Negative Affect Schedule

Table 2

Sample characteristics and questionnaire data of Study 2

	Experimental film conditions		Test of significance (<i>p</i>)	Cronbach's α
	Film on electromagnetic fields	Control film on stolen mobile phones		
Sample size <i>N</i>	40	42		
Sex (female/male)	28/12	29/13	Chi ² < 0.01 (.925)	
Age <i>M</i> (<i>SD</i>)	26.85 (9.15)	25.55 (9.41)	<i>t</i> (80) = 0.64 (.527)	
Proportion college students <i>N</i> (%)	30 (75.0)	26 (61.9)	Chi ² = 1.62 (.24)	
MHWS total score at pre test <i>M</i> (<i>SD</i>)	62.56 (17.43)	68.05 (17.43)	<i>t</i> (80) = -1.40 (.165)	.94
MHWS radiation at pre test <i>M</i> (<i>SD</i>)	5.88 (2.62)	6.79 (2.19)	<i>t</i> (80) = -1.71 (.091)	.78
EMF Health Worry Scale at pre test <i>M</i> (<i>SD</i>)	21.20 (7.63)	23.10 (6.58)	<i>t</i> (80) = -1.21 (.231)	.89
Tellegen Absorption Scale <i>M</i> (<i>SD</i>)	47.55 (22.71)	51.00 (25.44)	<i>t</i> (80) = -0.65 (.520)	.95
Trait anxiety (STAI) <i>M</i> (<i>SD</i>)	39.75 (7.88)	40.14 (9.90)	<i>t</i> (80) = -0.20 (.843)	.90
Negative State Affect (PANAS) <i>M</i> (<i>SD</i>)	15.50 (4.76)	17.74 (5.87)	<i>t</i> (80) = -1.89 (.062)	.82
Positive State Affect	25.83 (6.46)	25.52 (5.58)	<i>t</i> (80) = 0.23 (.822)	.83

(PANAS) <i>M</i> (SD)				
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Note. MHWS = Modern Health Worry Scale; EMF = Electromagnetic fields; STAI = State Trait Anxiety Inventory; PANAS = Positive and Negative Affect Schedule

Table 3

Zero-order correlations between relevant constructs at baseline assessment (for studies 1 above the diagonal, and for study 2 below the diagonal)

	Trait negative affect	Absorption	MHW	Positive state affect (PANAS)	Negative state affect (PANAS)
Trait negative affect		.25**	.03	-.33**	.34
Absorption	.10		.12	.24**	.37**
MHW	.27*	.27*		.33**	.12
Positive state affect (PANAS)	-.18	.18	.10		-.04
Negative state affect (PANAS)	.06	.13	.24*	-.13	

Note. MHW = Modern Health Worries; PANAS = Positive and Negative Affect Scale; ** $p < .01$; * $p < .05$

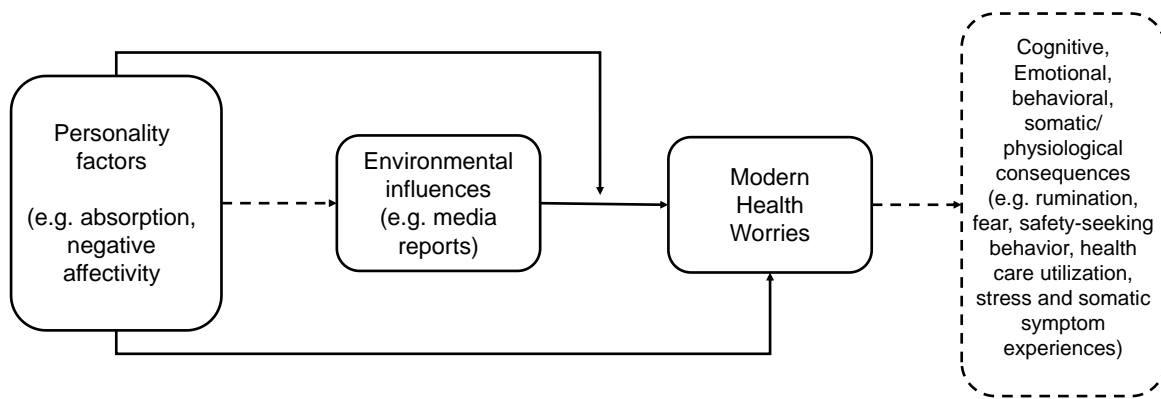


Figure 1. A hypothetical model depicting factors contributing to modern health worries. Broken lines indicate possible relations and constructs not included in the current studies.

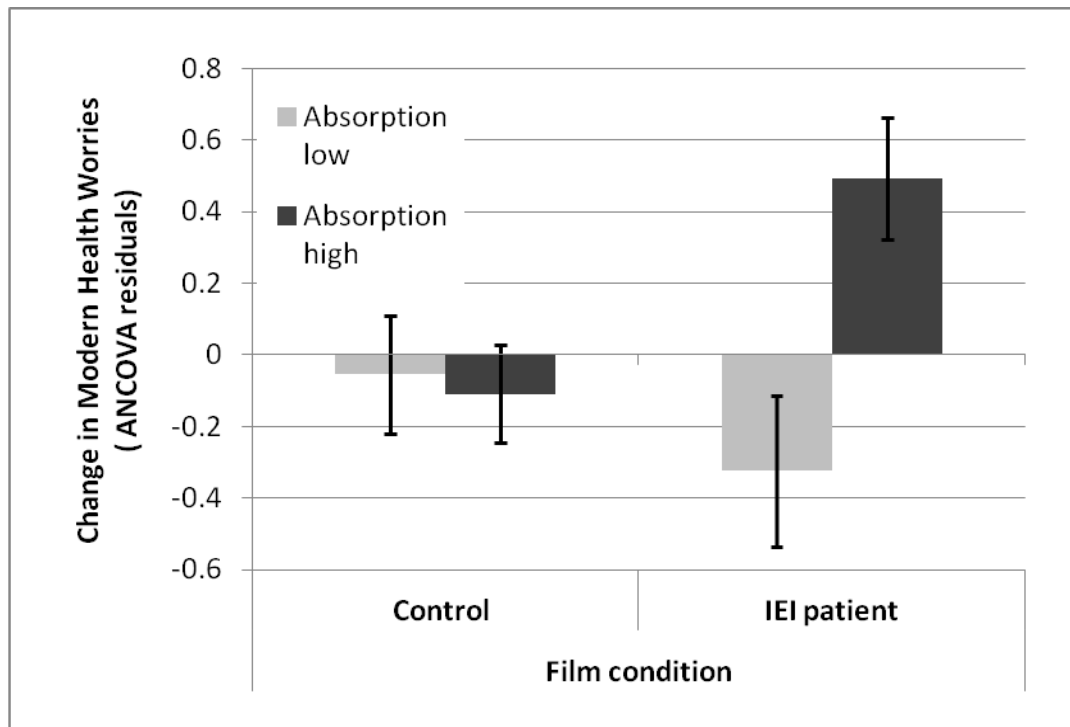


Figure 2. Modern health worries (MHW; total score) and the moderating role of absorption in the two film conditions of Study 1 (IEI related film versus control film on cystic fibrosis); error bars represent one standard error of the mean.

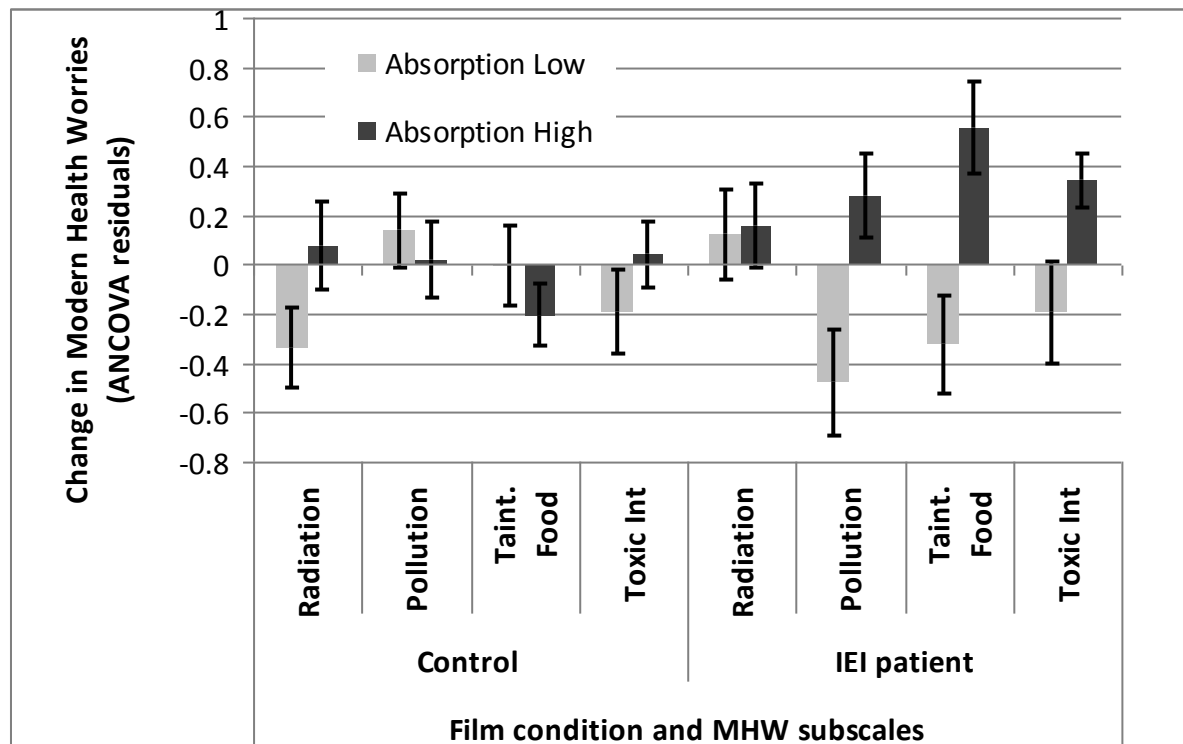


Figure 3. Modern health worries (MHW) subdivided according to the four subscales Radiation, Tainted Food, Environmental Pollution, and Toxic Interventions, and the moderating role of absorption in the two film conditions of Study 1 (IEI related film versus control film on cystic fibrosis); error bars represent one standard error of the mean.

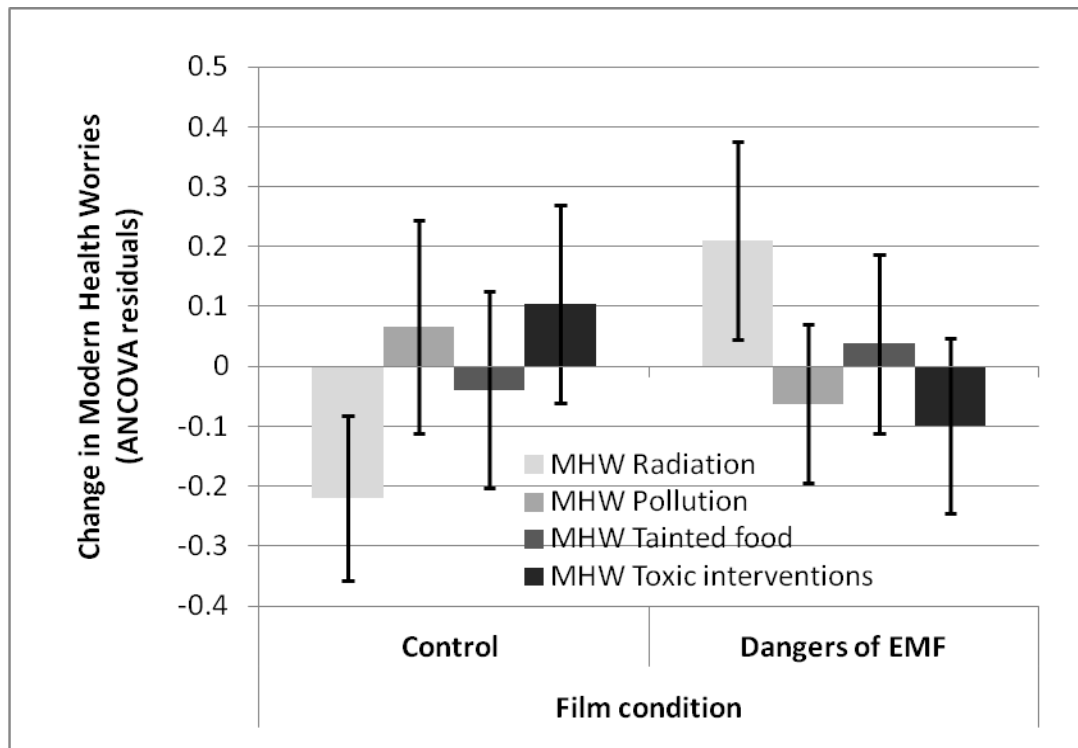


Figure 4. Changes in Modern Health Worries (MHW) after watching the two films (either on the dangers of electromagnetic fields or the control film on mobile phones); error bars represent one standard error of the mean.